VARIATIONS IN DIVERSITY OF MANGROVE CRABS IN TROPICAL AUSTRALIA

PETER J.F. DAVIE

Davie, P.J.F. 1994 06 30: Variations in diversity of mangrove crabs in tropical Australia. *Memoirs of the Queensland Museum* 36(1): 55-58, Brisbane. ISSN 0079-8835.

Species richness of crabs in seven estuaries in tropical northern Queensland and one in the Northern Territory varied markedly. Greatest diversities were found in the Queensland wet tropics and the Northern Territory site. Long periods of seasonal aridity combined with small estuary sizes have probably led to reduced diversity in the 'dry' tropics despite the lower latitude. □ *Diversity, tropics, ecology, biogeography, Crustacea, Decapoda, Brachyura, mangroves, intertidal, Australia, Queensland.*

Peter J.F. Davie, Queensland Museum, PO Box 3300, South Brisbane, Queensland 4101, Australia; 22 April 1994.

Mangrove communities have a diverse and specialised invertebrate fauna. Molluscs and crabs are the largest and most conspicuous elements of them. Although mollusc and crabs are equally diverse, crabs can be up to five times the biomass of other invertebrates (Golley et al., 1962). Crabs play a pivotal role in the health, functioning, and community structure of mangrove forests mainly through their burrowing and feeding activities. Few ecological studies on larger species show that burrowing and feeding activities of crabs are important (Jones, 1984; Robertson, 1991; Smith et al. 1991).

Mangroves are seen as murky, mosquito-infested wastelands and past collectors have shown disinterest in getting 'good-and-muddy. Hence, mangrove crabs are still poorly known. More than 120 species in eight families are associated with Australian mangroves, and over 20% of these are unnamed (Davie, 1982). Revisionary taxonomy of Australian mangrove crabs continues (Lucas & Davie, 1982; Davie, 1988, 1989, 1990, 1992, 1993a, b, 1994).

Two families, Grapsidae and Ocypodidae, contain almost all common mangrove inhabitants. Nearly half of all crab species in Australian mangroves are endemic to Australia. Mangrove forests on temperate coasts of New South Wales, Victoria and South Australia, are rarely extensive. Their sparse fauna is shared with adjacent rocky shore and mudflat habitats. Towards the tropics, mangrove tree species are more diverse and mangrove forests can occupy vast areas. Complexity of habitats yields a high diversity of mangrove crabs.

Knox (1963) recognised two marine coastal biogeographic tropical/sub-tropical provinces– Damperian and Solanderian Provinces. The first stretches north from about 28°S on the Western Australian coast to encompass north Australia as far as the Torres Strait; and the second extends along the east coast from Torres Strait to 25°S. Davie (1985) reviewed distributions of mangrove crab species. Results roughly agreed with these provinces. My recent data suggest, however, that the region south of the Kimberly on the west Australian coast is also an area of endemicity, with at least five endemic species. Strong separation of indigenous faunas implies a long independent evolution of coastal wetland ecosystems.

METHODS

Eight estuaries in northern Australia (Fig. 1) were visited for taxonomic studies in winter/spring, as sites are generally inaccessible during wet summers. Time spent at each site varied but, on at least three days, two people collected intensively at low-tide. All different habitats from seaward fringes at the mouth to the upstream limit of tidal influence were targeted. Collection was by digging with shovels, sieving, careful scrutiny of foliage, and breaking open fallen timber and logs. They were qualitative not quantitative. Collecting effort was roughly comparable for all sites and reliably reflected the number of species present. Data from other sites are not reliably complete. Full species lists for each site are available from the author.

RESULTS

The Murray River, just north of Cardwell, and Trinity Inlet, Cairns, show similar very high diversities. The next most diverse estuary is the Starcke River, c.150km north of Cooktown. The Murray and Starcke are similar sized small estuaries with comparable mangrove forest

FIG. 1. Study sites in Queensland.

development. Even though Starcke is c.380km north it has c.25% fewer crab species than the Murray River (Table 1). Two other sites north on the east coast both shared similar diversity but it was about half of those of the two Wet Tropics sites. East Alligator River in Kakadu, by contrast, has a high crab diversity but this is not different from the Cairns region, even though it is far more northerly and closer to the Indo-Malayan Achipelago, long considered the most diverse region anywhere.

I found other small rivers in northeastern Queensland, e.g. Claudie and Pascoe near Iron Range, very sandy with sparse mangrove development and apparently very low crab diversities. The evidently large North Kennedy system entering Princess Charlotte Bay may often carry freshwater and be of interest; it has not be sampled here.

Ocypodids are fewer in the 'dry tropics' (Table 1). These almost exclusive burrowers feed by seouring sediment, so their lower diversity may refleet the trend towards sandier substrates in many small estuaries of the dry tropics.

DISCUSSION

Alongi (1989, 1990) reviewed work on the tropieal soft-bottom benthos. He showed that while species diversity indisputably inereases with increasing latitude, the tropics are far from homogenous and alpha biodiversity is the result of local environmental conditions. Moore (1972) argued that extreme conditions in the tropics can place intertidal species under greater physical stress than their temperate relatives; this should be reflected in diversity in a given area and time.

Effects of regional conditions on species diversity of mangrove vegetation has been demonstrated (Semeniuk, 1983; Wells, 1982, 1983, 1985; Smith & Duke, 1987). Smith & Duke (1987) found differenees between 'eastern' (east of the Great Dividing Range) and 'western' (west of Torres Strait across northern Australia) mangrove forests. In eastern forests, longer estuaries with large eatehments tend to have more species than those that are shorter and have smaller eatehments. Also, high interannual rainfall variability and frequent cyclones depress species richness. These faetors showed no evident correlated with species richness in western forests where the most important physical deter-

TABLE 1. Numbers of crab species in eight north Australian estuaries.

REGION	LOCALITY	GRAPSIDAE	OCYPODIDAE	OTHER FAMILIES	TOTAL
QLD DRY TROPICS					
NW Cape York	Laradeenya Ck	12	4	2	18
	Andoom Ck, Weipa	5	5	3	13
NE Cape York	Muddy Bay	8	8	8	24
	Harmer Ck	15	7	2	24
	Starcke R.	14	10	10	34
QLD WET TROPICS	Cairns	16	15	13	44
	Murray R.	16	16	15	47
N.T.	E. Alligator R.	19	12	10	41

minant was the amount of freshwater seepage from the rearward terestrial fringe. The amount of yearly rainfall per se did not effect diversity but high variability was crucial.

Alongi (1987a, b; 1988a, b) found that microbial and meiofaunal communities in mangroves of north Queensland fluctuated significantly over time but mostly showed no obvious seasonality. Nematodes had low to moderate species diversity and few species per habitat but also, species composition varied from 35-90% seasonally. He attributed that to duration and intensity of monsoonal rains.

Crab survey data herein similarly suggest that small area diversity is greater in mangrove systems of high rainfall humid tropics of northeastern Queensland, from about Townsville to the Daintree, than in the more tropical, but seasonally drier, mangrove systems that have been studied. Many catchments in the watershed of the Great Dividing Range provide year round estuarine conditions with relatively reliable freshwater drainage. By contrast, small river systems of Cape York have estuarine parts for only a few months each year. They are effectively completely freshwater during the monsoon season and merely marine intrusions during the dry. Many mangrove crabs have specific salinity requirements both for adults and larval development and therefore need year-round estuarine conditions. Long periods of negligible rainfall and high temperatures can also lead to intolerable conditions such as parched soil and/or hypersaline soil porewater (>90 ppt) (Semeniuk, 1983). Low rainfall followed by seasonal scouring also means sandy or gravelly substrates are more common, which – because of the predominance of sediment feeders – typically means a lower diversity. The 'dry tropics' zone could be implicated in the biogeographic separation of eastern and northern Australian faunas (Davie, 1985) because of large distances lacking complex estuarine environments.

CONCLUSION

Crab diversity is crucial to, and an indicator of, productivity of mangrove areas. In eastern Australia, the most productive mangrove estuaries coincide with large human settlements and are therefore most threatened. All swamps are not the same, and this should be addressed during planning for mangrove habitat, and biodiversity, management. If the function of different mangrove systems are properly compared, we must adress potential differences in species composition and effects these might have.

ACKNOWLEDGEMENTS

I am very grateful to members of the Australian Littoral Society whom I accompanied into the field on many occasions, and in particular Peter Shanco and Eddie Hegerl. John Short, Queensland Museum, is also especially thanked for braving swamps with me and providing laboratory support. John Short and Leslie Newman provided helpful comments on the manuscript.

LITERATURE CITED

ALONGI, D.M. 1987a. Intertidal zonation and seasonality of meiobenthos in tropical mangrove estuaries. Marine Biology 95: 447-458.

1987b. Inter-estuary variation and intertidal zonation of free-livingnematode communities in tropical mangrove systems. Marine Ecology Progress Series 40: 103-114.

1988a. Bacterial productivity and microbial biomass in tropical mangrove sediments. Microbial Ecology 15: 59-79.

1988b. Microbial-meiofaunal interrelationships in some tropical intertidal sediments. Journal of Marine Research 46: 349-365.

1989. Ecology of tropical soft bottom benthos: a review with emphasis on emerging concepts. Revista de Biologia Tropical 37: 73-88.

1990. The ecology of tropical soft-bottom benthic ecosystems. Oceanography and Marine Biology Annual Review 28: 381-496.

DAVIE, P.J.F. 1982. A preliminary checklist of Brachyura (Crustacea: Decapoda) associated with Australian Mangrove Forests. Operculum 5: 204-7.

1985. The biogeography of littoral crabs (Crustacea: Decapoda: Brachyura) associated with tidal wetlands in tropical and sub-tropical Australia. In Chappell, J., Davie, J.D.S., & Woodroffe, C., (eds), 'Coasts and tidal wetlands of the Australian Monsoon region'. Proceedings of a conference held on 4-11 November 1984, Darwin. (N.A.R.U. Monograph Series: Darwin).

1988. A new genus and species of goneplacid (Crustacea: Brachyura) from Queensland, Australia. Memoirs of the Queensland Museum 25: 259-64.

1989. A re-appraisal of *Heteropanope* Stimpson, and *Pilumnopeus* A. Milne Edwards (Crustacea: Decapoda: Pilumnidae) with descriptions of new species and new genera. Memoirs of the Queensland Museum 27: 129-156.

1990. New and rare crabs of the subfamily Dotillinae (Crustacea: Ocypodidae) from northern

Australia and New Guinea. Memoirs of the Queensland Museum 28: 463-473.

1992. Revision of *Sarmatium* Dana (Crustacea: Brachyura: Sesarminae) with descriptions of three new species. Memoirs of the Queensland Museum 32: 79-97.

1993a. A new genus of macrophthalmine crab (Crustacea: Decapoda: Ocypodidae) from eastern Australia. Records of the Australian Museum 45: 5-9.

1993b. A new species of sesarmine crab (Brachyura: Grapsidae) from Japan and Taiwan, previously known as *Sesarma erythodactyla* Hess, 1865. Crustacean Research 22: 65-74.

1994. Revision of the genus *Neosarmatium* Serène and *Soh* (Crustacea: Brachyura: Sesarminae) with description of two new species. Memoirs of the Queensland Museum 35: 35-74.

GOLLEY, F., ODUM, H.T. & WILSON, R.F. 1962. The structure and metabolism of a Puerto Rican red mangrove forest in May. Ecology 43: 9-19.

JONES, D.A. 1984. Crabs of the mangal ecosystem. Pp. 89-109. In Por, F.D. & Dor, I. (eds) 'Hydrobiology of the Mangal', (W. Junk: The Hague).

KNOX, G.A. 1963. The biogeography and intertidal ecology of the Australasian coasts. Oceanography and Marine Biology 1: 341-404.

LUCAS, J.S. & DAVIE, P.J.F. 1982. Hymenosomatid crabs of Queensland estuaries and tidal mud flats, including descriptions of four new species of *Elamenopsis* A. Milne-Edwards and a new species of *Amarinus* Lucas. Memoirs of the Queensland Museum 20: 401-419.

MOORE, H.B. 1972. Aspects of stress in the tropical marine environment. Advances in Marine Biology 10: 217-269.

ROBERTSON, A.I. 1991. Plant-animal interactions and the structure and function of mangrove forest ecosystems. Australian Journal of Ecology 16: 433-443.

SEMENIUK, V. 1983. Mangrove distribution in northwestern Australia in relationship to regional and local freshwater seepage. Vegetation 53: 11-31.

SMITH III, T.J. & DUKE, N.C. 1987. Physical determinants of inter-estuary variation in mangrove species richness around the tropical coastline of Australia. Journal of Biogeography 14: 9-19.

SMITH III, T.J., BOTO, K.G., FRUSHER, S.D. & GIDDINS, R.L. 1991. Keystone species and mangrove forest dynamics: the influence of burrowing by crabs on soil nutrient status and forest productivity. Estuarine, Coastal and Shelf Science 33: 419-432.

WELLS, A.G. 1982. Mangrove vegetation of northern Australia. Pp. 57-78. In Clough, B.F. (ed.), 'Mangrove Ecosystems in Australia' (A.N.U. Press: Canberra).

1983. Distribution of mangrove species in Australia, Pp. 57-76. In Teas, H.J. (ed.) 'Biology and ecology of mangroves'. (W. Junk : The Hague).

1985. Grouping of tidal systems in the Northern Territory and Kimberly region of Western Australia on presence/absence of mangrove species, Pp. 167-186. In Chappell, J., Davie, J.D.S., and Woodroffe, C., (eds) 'Coasts and tidal wetlands of the Australian Monsoon region'. Proceedings of a conference held on 4-11 November 1984, Darwin. (N.A.R.U. Monograph Series: Darwin).